COMPARISON OF WATER DEMANDS TO CURRENT SUPPLIES

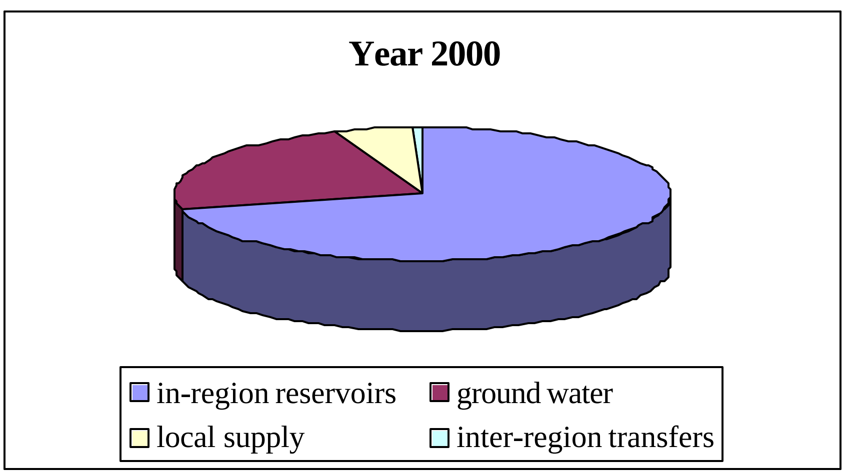
TEXAS STATE SENATE BILL 1

REGION B

4.1 Current Supply

The current supply in Region B consists of surface water from in-region reservoirs, groundwater, local supplies, and inter-regional transfers. Based on the year 2000 yields, the total in-region reservoir water supply in Region B is estimated at 180,500 acre-feet per year. This supply is projected to decrease by 14 percent to 155,000 acre-feet per year in 2050. The total developed groundwater supply in the region is about 59,000 acre-feet per year, with the Seymour Aquifer accounting for 71 percent and Blaine Aquifer accounting for 21 percent of the supply. The Trinity Aquifer provides only a small portion of the region's available supply. Since groundwater availability generally does not include mining of the aquifers, the groundwater supply is not projected to decline over the planning period. Local supplies consist of on-farm stock ponds, small reservoirs and several run of the river rights. Inter-regional transfers account for only a small percentage of the total water supply in the region, and include supply from Greenbelt Lake and groundwater from Dickens County. The total current available supply for the region is approximately 252,000 acre-feet per year. The existing distribution of supply by source type is shown on Figure 4-1.

Figure 4-1 Distribution of Current Supplies



4.2 Regional Demands

Regional demands were developed by city, county and category and are discussed in Chapter 2. In summary, the total demands for the region are projected to increase slightly from 169,600 to 183,200 acre-feet per year. The largest water demand category is irrigation, accounting for over 50 percent of the total use. Municipal and steam electric power are the next two largest water users in Region B. Mining is the smallest water demand category, accounting for less than 1 percent of the total demands. Most of the demands by category are not anticipated to change much over the planning period, with the exception of steam electric power. A proposed new power plant in Archer County will significantly increase the demands for that category.

4.3 Comparison of Supply and Demand

A comparison of current supply to demand was performed using the projected demands developed in Chapter 2 and the allocation of existing supplies developed in Chapter 3 as evaluated under drought of record conditions. As discussed in Chapter 3, allocations of existing supplies were based on the most restrictive of current water rights, contracts and available yields for surface water and historical use and groundwater availability for groundwater. The allocation process did not directly address water quality issues, such as nitrates. Salinity was addressed to some extent by not assigning supplies with known high salinity levels for municipal use. This included Lake Kemp and most of the Blaine Aquifer. Further discussion of water quality issues and the effect on supply is presented in Section 4.4.

As a region, there is adequate supply to meet the region's needs. A comparison of the total regional supply to demand is shown on Figure 4-2. Comparisons for the three largest water use types, irrigation, municipal and steam electric power are shown on Figures 4-3 through 4-5.

Figure 4-2 Supply and Demand for Region B

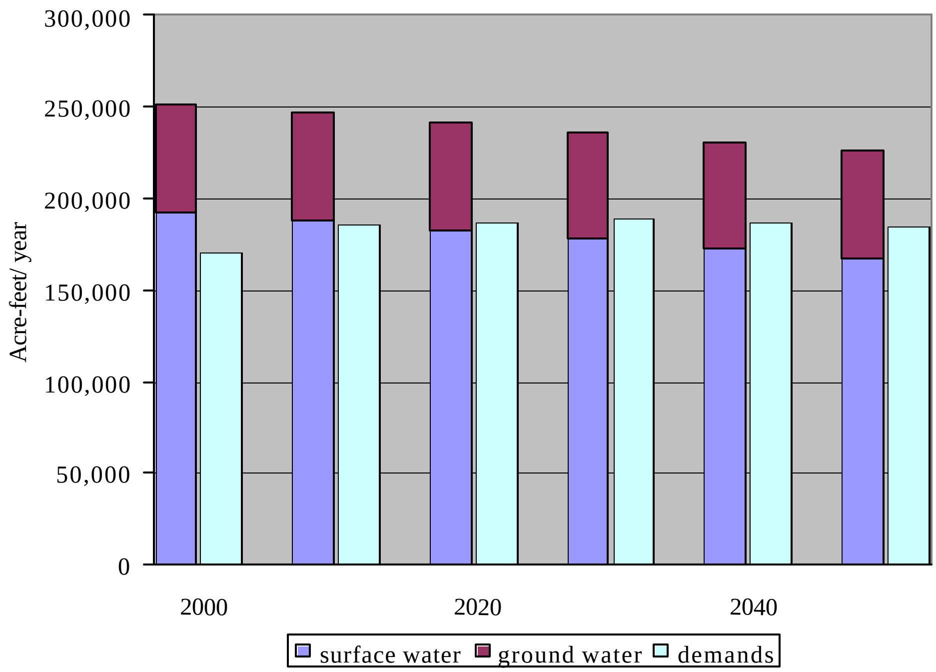


Figure 4-3 Irrigation Supply and Demand for Region B

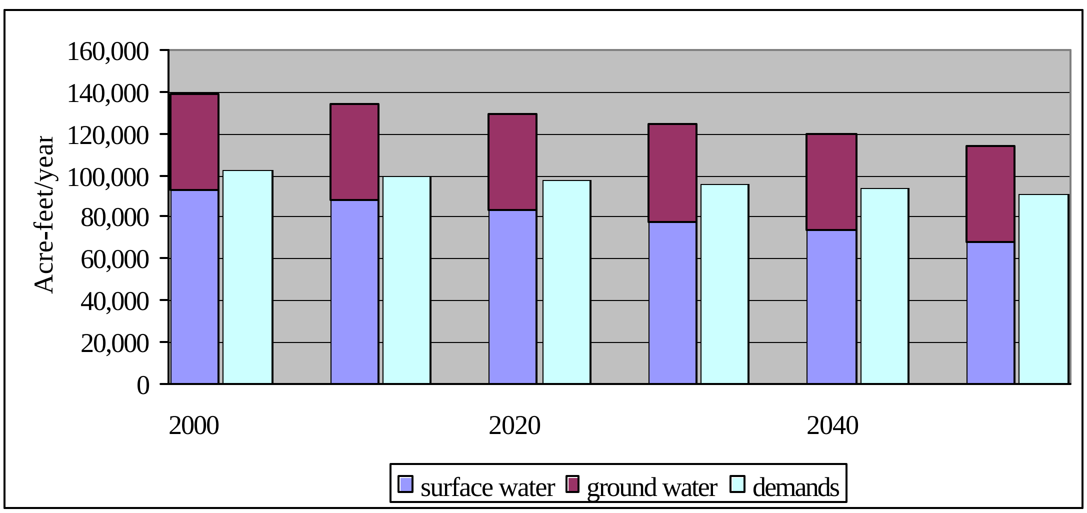


Figure 4-4 Municipal Supply and Demand for Region B

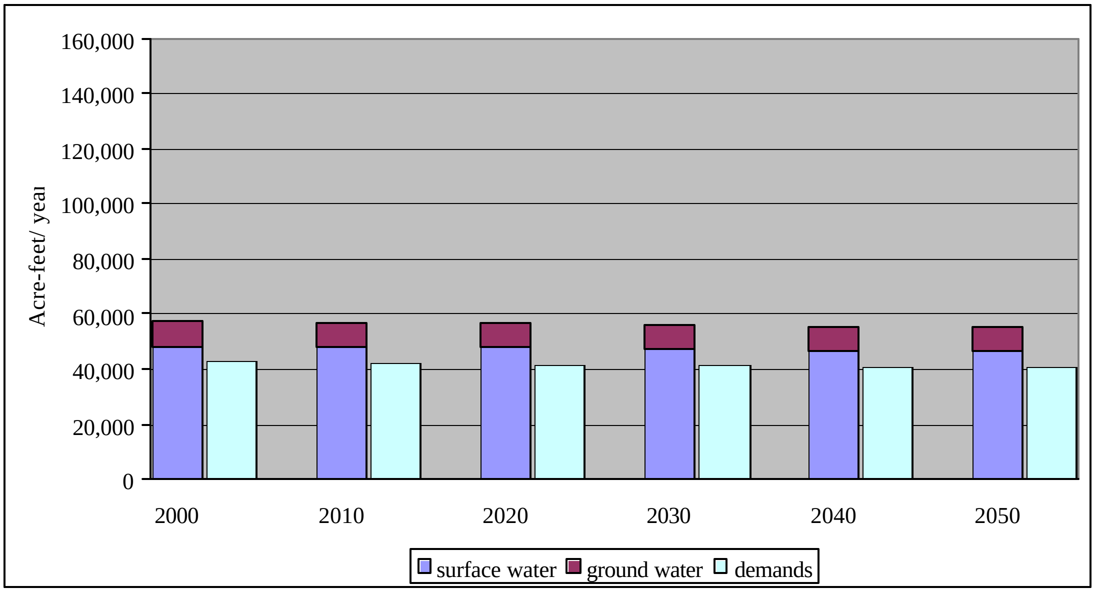
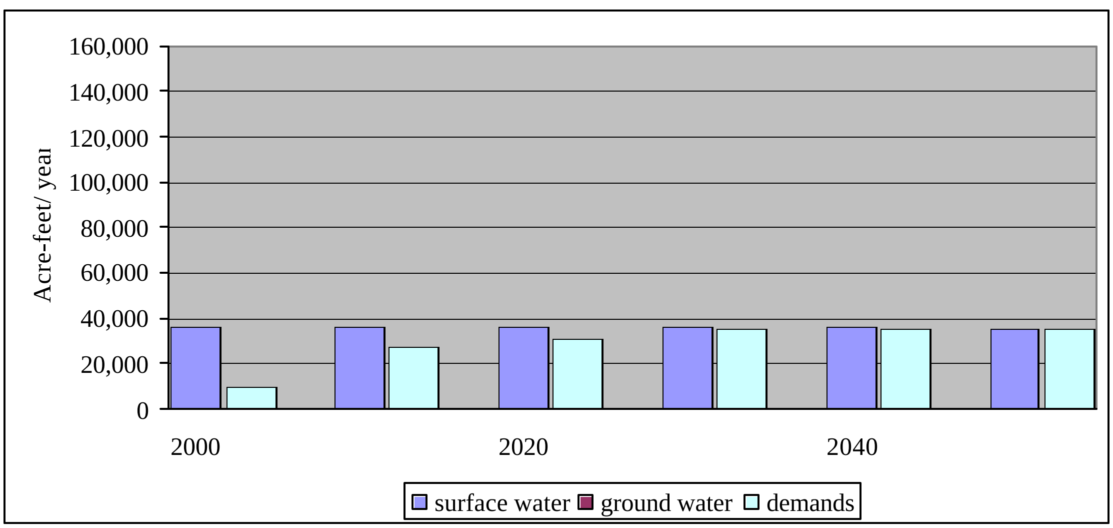


Figure 4-5 Steam Electric Power Supply and Demand for Region B



A summary of supply and demands by county for the years 2000 and 2050 are presented in Tables 4-1 and 4-2, respectively, and the comparison of supply versus demands by user group for Region B is presented on Table 4-3. There are only three identified shortages that cannot be met by existing infrastructure and supply. The municipal needs for the City of Vernon and manufacturing needs in Wilbarger County, which are supplied by Vernon, and the municipal needs of the City of Electra. These shortages are projected to be imminent, and both cities are currently investigating new supply sources and other alternatives. Discussion of the management strategies for these entities is presented in Chapter 5. Table 4-4 presents the identified water users with identified shortages over the planning period.

Table 4-1 Comparison of Supply versus Demand by County – Year 2000

County	Irrigation		Manufacturing		Mining		Municipal		Steam Electric		Livestock	
	Supply	Demand	Supply	Demand	Supply	Demand	Supply	Demand	Supply	Demand	Supply	Demand
Archer	4,891	3,600	0	0	1	0	2,752	1,688	14,000	0	2,711	2,711
Baylor	2,212	707	0	0	47	32	1,003	980	0	0	1,104	953
Clay	5,291	4,000	0	0	508	308	3,947	1,654	0	0	2,201	2,191
Cottle	4,584	4,434	0	0	23	25	870	796	0	0	476	387
Foard	5,255	4,978	0	0	23	23	494	393	0	0	291	289
Hardeman	7,295	4,999	347	347	7	3	1,039	936	1,655	1,000	496	480
King	750	20	0	0	0	0	365	355	0	0	771	771
Montague	531	297	10	7	641	627	4,907	2,921	0	0	1,850	1,850
Wichita	72,245	60,000	2,172	2,172	594	134	38,071	27,545	360	360	778	740
Wilbarger	23,989	19,071	**685**	**740**	40	24	**3,346**	**3,397**	20,000	8,100	1,797	1,797
Young							2,031	730				

Table 4-2 Comparison of Supply versus Demand by County – Year 2050

County	Irrigation		Manufacturing		Mining		Municipal		Steam Electric		Livestock	
	Supply	Demand	Supply	Demand	Supply	Demand	Supply	Demand	Supply	Demand	Supply	Demand
Archer	3,100	3,100	0	0	1	0	2,690	1,471	14,000	14,000	2,711	2,711
Baylor	2,212	607	0	0	47	0	976	655	0	0	1,104	953
Clay	3,500	3,500	0	0	508	180	3,920	1,410	0	0	2,201	2,191
Cottle	4,584	3,808	0	0	23	30	753	520	0	0	476	387
Foard	5,255	4,275	0	0	27	27	411	295	0	0	291	289
Hardeman	7,295	4,293	480	480	7	2	911	806	1,387	1,000	496	480
King	750	20	0	0	0	0	356	303	0	0	771	771
Montague	531	297	24	24	641	490	4,689	2,321	0	0	1,850	1,850
Wichita	55,000	55,000	2,814	2,814	594	39	36,866	27,373	360	360	778	740
Wilbarger	23,989	16,377	**685**	**1,206**	40	24	3,346	3,267	20,000	20,000	1,797	1,797
Young							2,031	672				

Table 4-3 Difference of Supply and Demand by User Group

WATER USER GROUP	COUNTY	BASIN	2000	2010	2020	2030	2040	2050
ARCHER CITY	ARCHER	RED	351	357	372	383	394	406
COUNTY-OTHER	ARCHER	BRAZOS	0	0	22	20	23	23
COUNTY-OTHER	ARCHER	RED	442	437	461	475	488	498
COUNTY-OTHER	ARCHER	TRINITY	0	0	0	5	5	5
HOLLIDAY	ARCHER	RED	0	0	0	0	0	0
IRRIGATION	ARCHER	RED	1,291	548	365	183	1	0
LAKESIDE CITY	ARCHER	RED	214	211	204	202	206	208
LIVESTOCK	ARCHER	BRAZOS	0	0	0	0	0	0
LIVESTOCK	ARCHER	RED	0	0	0	0	0	0
LIVESTOCK	ARCHER	TRINITY	0	0	0	0	0	0
MINING	ARCHER	RED	1	1	1	1	1	1
SCOTLAND	ARCHER	RED	56	54	66	72	75	78
STEAM ELECTRIC POWER	ARCHER	RED	14,000	0	0	0	0	0
COUNTY-OTHER	BAYLOR	BRAZOS	0	0	0	0	0	0
COUNTY-OTHER	BAYLOR	RED	8	13	15	17	17	18
IRRIGATION	BAYLOR	BRAZOS	1,335	1,350	1,364	1,378	1,392	1,406
IRRIGATION	BAYLOR	RED	170	177	182	188	194	199
LIVESTOCK	BAYLOR	BRAZOS	57	57	57	57	57	57
LIVESTOCK	BAYLOR	RED	94	94	94	94	94	94
MINING	BAYLOR	BRAZOS	15	26	37	42	47	47
SEYMOUR	BAYLOR	BRAZOS	15	79	197	261	284	303
BYERS	CLAY	RED	0	4	11	15	16	15
COUNTY-OTHER	CLAY	RED	1,420	1,483	1,556	1,598	1,659	1,610
COUNTY-OTHER	CLAY	TRINITY	11	27	39	44	50	50
HENRIETTA	CLAY	RED	862	863	867	853	836	835
IRRIGATION	CLAY	RED	1,291	548	365	183	1	0
LIVESTOCK	CLAY	RED	0	0	0	0	0	0
LIVESTOCK	CLAY	TRINITY	10	10	10	10	10	10

Table 4-3 (continued) Difference of Supply and Demand by User Group

WATER USER GROUP	COUNTY	BASIN	2000	2010	2020	2030	2040	2050
MINING	CLAY	RED	198	283	307	321	325	325
MINING	CLAY	TRINITY	2	3	3	3	3	3
PETROLIA	CLAY	RED	0	0	0	0	0	0
COUNTY-OTHER	COTTLE	RED	0	0	0	0	0	0
IRRIGATION	COTTLE	RED	150	283	412	537	659	776
LIVESTOCK	COTTLE	RED	89	89	89	89	89	89
MINING	COTTLE	RED	0	0	0	0	0	0
PADUCAH	COTTLE	RED	74	104	141	173	205	233
COUNTY-OTHER	FOARD	RED	101	106	108	109	110	116
CROWELL	FOARD	RED	0	0	0	0	0	0
IRRIGATION	FOARD	RED	277	426	571	712	848	980
LIVESTOCK	FOARD	RED	2	2	2	2	2	2
MINING	FOARD	RED	0	0	0	0	0	0
CHILLICOTHE	HARDEMAN	RED	19	22	24	24	25	25
COUNTY-OTHER	HARDEMAN	RED	84	90	82	84	83	80
IRRIGATION	HARDEMAN	RED	2,296	2,446	2,591	2,732	2,869	3,002
LIVESTOCK	HARDEMAN	RED	16	16	16	16	16	16
MANUFACTURING	HARDEMAN	RED	0	0	0	0	0	0
MINING	HARDEMAN	RED	4	4	4	5	5	5
QUANAH	HARDEMAN	RED	0	0	0	0	0	0
STEAM ELECTRIC POWER	HARDEMAN	RED	655	601	548	494	440	387
COUNTY-OTHER	KING	BRAZOS	1	1	1	3	3	3
COUNTY-OTHER	KING	RED	0	0	0	0	0	0
GUTHRIE	KING	RED	9	11	17	28	40	50
IRRIGATION	KING	RED	730	730	730	730	730	730
LIVESTOCK	KING	BRAZOS	0	0	0	0	0	0
LIVESTOCK	KING	RED	0	0	0	0	0	0
BOWIE	MONTAGUE	TRINITY	1,367	1,404	1,411	1,392	1,361	1,327

Table 4-3 (continued) Difference of Supply and Demand by User Group

WATER USER GROUP	COUNTY	BASIN	2000	2010	2020	2030	2040	2050
COUNTY-OTHER	MONTAGUE	RED	66	96	116	142	161	157
COUNTY-OTHER	MONTAGUE	TRINITY	91	172	195	232	265	323
IRRIGATION	MONTAGUE	RED	160	160	160	160	160	160
IRRIGATION	MONTAGUE	TRINITY	74	74	74	74	74	74
LIVESTOCK	MONTAGUE	RED	0	0	0	0	0	0
LIVESTOCK	MONTAGUE	TRINITY	0	0	0	0	0	0
MANUFACTURING	MONTAGUE	RED	3	1	0	0	0	0
MINING	MONTAGUE	RED	14	134	156	162	156	143
MINING	MONTAGUE	TRINITY	0	2	4	6	8	8
MONTAGUE	MONTAGUE	RED	0	0	0	0	0	2
NOCONA	MONTAGUE	RED	415	448	479	492	500	502
SAINT JO	MONTAGUE	RED	12	16	14	14	14	15
SAINT JO	MONTAGUE	TRINITY	35	44	39	40	41	42
BURKBURNETT	WICHITA	RED	1,824	1,846	1,883	1,888	1,884	1,869
COUNTY-OTHER	WICHITA	RED	2,214	2,164	2,157	2,165	2,164	2,181
ELECTRA	WICHITA	RED	-65	-63	-61	-51	-52	-57
IOWA PARK	WICHITA	RED	1,451	1,480	1,494	1,496	1,492	1,482
IRRIGATION	WICHITA	RED	12,245	9,863	6,577	3,293	17	0
LIVESTOCK	WICHITA	RED	38	38	38	38	38	38
MANUFACTURING	WICHITA	RED	0	0	0	0	0	0
MINING	WICHITA	RED	460	508	516	524	548	555
PLEASANT VALLEY	WICHITA	RED	0	0	0	0	0	0
SHEPPARD AFB	WICHITA	RED	2,429	2,429	2,429	2,429	2,429	2,429
STEAM ELECTRIC POWER	WICHITA	RED	0	0	0	0	0	0
WICHITA FALLS	WICHITA	RED	5,102	4,886	4,883	4,711	4,412	4,018
COUNTY-OTHER	WILBARGER	RED	221	194	189	186	187	170
IRRIGATION	WILBARGER	RED	4,918	5,490	6,045	6,583	7,105	7,612
LIVESTOCK	WILBARGER	RED	0	0	0	0	0	0

Table 4-3 (continued) Difference of Supply and Demand by User Group

WATER USER GROUP	COUNTY	BASIN	2000	2010	2020	2030	2040	2050
MANUFACTURING	WILBARGER	RED	-55	-164	-219	-286	-402	-521
MINING	WILBARGER	RED	16	17	16	16	16	16
STEAM ELECTRIC POWER	WILBARGER	RED	11,900	8,000	4,000	0	0	0
VERNON	WILBARGER	RED	-272	-167	-137	-147	-105	-91
OLNEY	YOUNG	BRAZOS	1,301	1,304	1,324	1,338	1,351	1,359

NOTE: Negative numbers indicate a shortage and a positive number indicates allocated supply in excess of projected demands.

Supply is based on allocations developed for Chapter 3, Appendix B, Table 5, incorporating the modifications specified on Table 4-2.

Demands were developed in Chapter 2 and summarized in Appendix B, Table 2.

Table 4-4 Identified Supply Needs for Region B

WATER USER GROUP	COUNTY	BASIN	2000	2010	2020	2030	2040	2050
ELECTRA	WICHITA	RED	-65	-63	-61	-51	-52	-57
MANUFACTURING	WILBARGER	RED	-55	-164	-219	-286	-402	-521
VERNON	WILBARGER	RED	-272	-167	-137	-147	-105	-91

NOTE: Supply needs based on firm yield analysis of surface water reservoirs and available supply from existing groundwater well fields.

4.4 EFFECT OF WATER QUALITY ON SUPPLY

Based on Table 4-3, an adequate supply of water is available for the various user groups and types of use within Region B as a whole. Many water user groups have supplies that exceed their projected needs. However, a few individual systems are projected to experience shortages of water during the planning period.

An implied assumption of the supply analysis is that the quality of existing water supplies is acceptable for the listed use. In other words, water supplies that are currently being used are assumed to continue to be available, regardless of the quality. However, Senate Bill 1 also requires that water quality issues be considered when determining the availability of water during the planning period. For this report, evaluations of source water quality are generally confined to waters used for human consumption. The effect of water quality of Lake Kemp on agricultural use is also reviewed.

4.4.1 Municipal Water Systems with Existing or Potential Quality Concerns

To determine whether the quality of specific sources of supply imposes a potential limitation on their use, the quality of the major sources of supply was compared to current and proposed drinking water standards. Pursuant to the Federal Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) has adopted maximum contaminant levels (MCLs) for a list of organic and inorganic contaminants of drinking water. This list constitutes the primary drinking water standards, and water used for human consumption is to comply with the MCLs established by this list. The EPA is considering a number of changes to the primary drinking water standards. These potential changes include the addition of MCLs for a number of contaminants not currently on the list and the lowering of MCLs for some currently regulated contaminants. Consideration of the proposed standards when evaluating water quality is important because of the length of the planning horizon. Revised standards will be in effect long before the year 2050 and could potentially have a substantial impact on the availability of water supplies.

The consulting team reviewed the Texas Natural Resource Conservation Commission (TNRCC) records that identify systems that are not compliant with current and proposed primary drinking water standards. Compliance with secondary drinking water standards was not evaluated since the secondary standards do not have the same regulatory and public health implications. Also, compliance with the bacteriological standards (total coliform and fecal coliform) was not evaluated since violations of these standards, when they occur, are typically associated with operational techniques and not the quality of the raw water supply. The water systems in Region B that have existing or potential noncompliances were identified, and the parameter of concern was also identified. Table 4-5 provides the results of the review.

Table 4 - 5

Water Systems Not Compliant with Primary Drinking Water Quality Standards

Water System	County	Water Source	CURRENT STANDARD
			NO_3
			MCL = 10mg/L
Baylor WSC	Baylor	Seymour Aquifer	X
Seymour	Baylor	Seymour Aquifer	X
Byers	Clay	Seymour Aquifer	X
Charlie WSC	Clay	Seymour Aquifer	X
Thalia WSC	Foard	Seymour Aquifer	X
Burkburnett	Wichita	Seymour Aquifer and Wichita System	X
Friberg-Cooper WSC	Wichita	Seymour Aquifer	X
Electra	Wichita	Seymour Aquifer and Electra City Lake	X
Box Community Water System	Wilbarger	Seymour Aquifer	X
Lockett Water System	Wilbarger	Seymour Aquifer	X
Oklaunion WSC	Wilbarger	Seymour Aquifer	X
Hinds-Wildcat Water System	Wilbarger	Seymour Aquifer	X
Vernon	Wilbarger	Seymour Aquifer	X

The TNRCC records indicate that the only primary drinking water standard (other than bacteriological) currently exceeded by water users in Region B is the nitrate criterion.

Thirteen water users have water supplies that exceed the MCL for nitrate. There are also two systems that may not comply with the proposed arsenic drinking water standard. However, since the EPA has not published the preferred MCL for arsenic, it is premature to assess compliance with this standard.

4.4.2 Nitrate Concerns

The nitrate MCL is 10 mg/L. Consumption of water with nitrate levels in excess of 10 mg/L by infants can cause methemoglobinemia or "blue baby syndrome", a potentially fatal condition. Additionally, pregnant women are urged not to drink water with a high concentration of nitrates because of the potential health effects on the unborn fetus.

In Region B, moderate to high nitrate levels are found in water from the Seymour Aquifer. These concentrations are partly attributed to agricultural activities in the area. Long-standing practices associated with fertilizing crops are believed to have caused an increase in nitrates in the groundwater. Not all water produced from the Seymour Aquifer has excessive nitrates, but the water users shown in Table 4 -5 have historically exhibited nitrate concentrations that range from slightly above the MCL of 10 mg/L to over 25 mg/L, in some cases.

Removal of nitrates from water can be expensive. Reverse osmosis or a comparable advanced membrane technique is required. Nitrates can also be reduced by blending the water with another water source with low nitrate levels, f such a source is available and otherwise of acceptable quality. The TNRCC currently is urging all water systems in the region using water with high nitrate levels to reduce the nitrate concentration by treatment, by blending, or by securing an alternate source of water. Deadlines for these water users to achieve the drinking water standard for nitrate have not been set. However, it can be expected that the TNRCC will continue to work toward achieving this goal and may eventually set deadlines for compliance.

According to the demand projection in Chapter 2, municipal water use for the 13 water users in Table 4-5 is estimated to be slightly less than 7,000 acre-feet in the year 2000, and the usage is projected to remain relatively constant throughout the planning period. These users account for about 17 percent of all municipal water use in the region. For many of these users, groundwater from the Seymour Aquifer is the only supply source. For the cities of Burkburnett and Electra, groundwater is only a portion of their supply. The largest water users in Region B that exceed the nitrate MCL and the estimated current groundwater supply are as follows:

- Vernon (2,800 acre-feet)
- Burkburnett (916 acre-feet)
- Seymour (747 acre-feet)
- Baylor Water Supply Corporation (WSC) (220 acre-feet)

The remaining water systems that exceed the nitrate MCL are projected to use approximately 700 acre-feet of water in 2000. Many of these systems have ongoing efforts to reduce the nitrate levels in their water. Several of these systems are working together to solve their problems. It is expected that the majority of these users will achieve substantial reductions within a few years. In some cases, the proposed program to improve the quality of the water supply includes obtaining water from another supplier or a different raw water source. These plans will be summarized in the discussion of alternative water supply plans presented in Chapter 5.

Due to the fact that most affected water systems are expected to solve their nitrate problem within a few years, the estimated volume of water available from the Seymour Aquifer has not been reduced based on quality limitations. However, the Seymour Aquifer should not be considered as an available source for municipal water use beyond the current usage, except in those areas where supplies do not exceed the nitrate MCL, or a supply strategy is identified that provides for achieving compliance with the nitrate standard.

4.4.3 Arsenic Concerns

The concentration of arsenic in water supplies is regulated because arsenic is believed to be a carcinogen. Currently, the MCL for arsenic is 50 ug/L. However, adoption of a lower MCL has been under evaluation by EPA for some time. Several alternative MCLs are currently being considered. According to the TNRCC, the EPA is considering a limit between 3 ug/L and 10 ug/L. The proposed MCL for arsenic is to be published for comments in May 2000, with the intent of adoption by September 2000.

Limited data available on the water sources in Region B suggest that Lake Arrowhead may contain arsenic levels above the lower limit of consideration. Several systems that rely entirely on water from Lake Arrowhead reported arsenic concentrations of 6 ug/L in 1999. Lake Arrowhead is a major source of water for the region and is used as supply for many water systems. While arsenic may be a potential water quality problem, further information is needed before it can be determined if any of the water supply in Region B is impacted because of the presence of arsenic. A decision by EPA is needed regarding the revised MCL for arsenic. Also, additional testing of Lake Arrowhead water should be performed to determine more accurately the current arsenic levels in the lake. If the arsenic concentrations in Lake Arrowhead are found to exceed the new MCL, then additional treatment or blending with another source may be required.

4.4.4 Salinity Concerns for Lake Kemp and Diversion Lake

Waters in the Wichita River Basin have historically exhibited high dissolved solids and chloride concentrations. Previous studies, dating back to 1957, have documented that the salt concentrations in the area significantly limit the use of these waters for municipal, industrial, and irrigation purposes.

The U.S. Army Corps of Engineers (USACE) determined that an average of over 3,600 tons per day of chlorides was being discharged to the Red River system from natural and man-made sources. A project, known as the Chloride Control Project, has been designed to reduce the amount of salt contamination from eight of the Red River

Basin’s natural salt sources, three of which lie within the Wichita River Basin. To date only one of the proposed chloride control facilities has been constructed and is operational. This low-flow dam structure on the South Wichita River (within the Lake Kemp drainage basin) retains low flows that are high in salts, and diverts them via a pump station and pipeline to Truscott Brine Reservoir. Low-flow diversion dams are also planned for the Middle and North Wichita Rivers. When constructed, high chloride water that would normally flow to Lake Kemp and Diversion Lake would be diverted to the Truscott Brine Reservoir.

Recent water quality data of the Lake Kemp/Diversion system indicate that chloride levels have reduced since completion of the first chloride control project, but they still limit the water use. The primary uses impacted by the lakes’ salt content are potable water supplies and irrigation. Water quality criteria established pursuant to the Safe Drinking Water Act considers high salt content aesthetically undesirable, and is regulated under the secondary drinking water standards. Chloride, sulfate, and total dissolved solids concentrations are subject to the secondary standards. The TNRCC established criteria for these parameters are somewhat higher than EPA criteria, and water systems in Texas are subject to the state criteria. Both the TNRCC and EPA standards and typical Lake Kemp levels for these parameters are presented in Table 4-6.

Table 4-6

Secondary Drinking Water Standards and Salinity Levels of Lake Kemp

Parameter	**TNRCC Criteria**	**EPA Criteria**	**Lake Kemp/Diversion Typical concentration**
Chloride (mg/L)	300	250	800 – 1,200
Sulfate (mg/L)	300	250	550 – 800
Total Dissolved Solids (mg/L)	1,000	500	2,000 – 3,500

It is sometimes possible to use water with salt concentrations that exceed the drinking water criteria by blending it with waters with lower salt content. This practice may be considered in the Wichita River Basin, but is often limited to emergency use only. At the present time, a blend containing less than 25 percent of the waters from Lake Kemp or Diversion Lake is typically necessary if TNRCC criteria are to be achieved. This obviously limits the extent to which waters from these reservoirs can be used for potable supply.

The salinity of irrigation water from Lake Kemp can also limit the crops to which it can be applied. There are several systems for classifying the salinity of waters that characterize the suitability of the water for various types of crops. One classification system developed by the U.S. Department of Agriculture (USDA) in 1954 identifies four classes of water, based on the chloride concentration of the water, and describes the suitability of each class for irrigation. The classes and their corresponding description of suitability are as follows:

Class I Low Salinity Water *Chloride < 250 mg/L*	Water is considered excellent to good and suitable for most plants growing on most soils with little likelihood that soil salinity will develop.
Class II Medium Salinity Water *Chloride > 250 mg/L, but* *Chloride < 750 mg/L*	Water can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.
Class III High Salinity Water *Chloride > 750 mg/L, but* *Chloride < 2,150 mg/L*	Water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required, and plants with good salt tolerance should be selected.
Class IV Very High Salinity *Chloride > 2,150 mg/L*	Water is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. Only very salt tolerant crops should be selected.

The water in Lake Kemp and Diversion Lake is generally Class III. Therefore, its use for irrigation is limited to plants with high salt tolerance. The USDA Plant Sciences Group has performed research on the salt tolerance of various herbaceous crops, and examples of salt tolerant crops include cotton, barley, sugar beet, Bermuda grass, and asparagus.

4.5 System Limitations

In addition to water supply and water quality issues, system limitations were identified for the municipalities within the region. System limitations include water treatment plant design capacity, major water transmission pipelines and associated pumping facilities. Distribution systems and storage facilities within a community were not addressed.

Municipal water systems are typically designed for peak flow conditions. The water supply analysis presented in Section 4.3 considered average day conditions and did not address limitations associated with peak demands. To assess peak demands for the municipalities in Region B, a peaking factor was applied to the average day demands developed in Chapter 2. Many of the larger municipalities provided this peaking factor based on historical use and these are shown on Table 4-7. For those users without a known peaking factor, a factor of 2 was assumed.

Water treatment plant capacities for surface water treatment were provided from a TNRCC database and confirmed by the municipalities. Transmission pipeline capacities were estimated from pipe diameters and average flow velocities. The water users provided the pumping capacities for the major transmission systems. Water treatment plant capacities were evaluated for all users who receive treated water from that system. For example, for the City of Wichita Falls, the sum of the peak demands for all treated water customers was compared to the City's water treatment plant's capacity. For customers that receive both raw and treated water, a representative portion of the customer's peak demand for treated water was determined. In addition to the physical system limitations, a comparison of available supply to peak demands was made for those entities with a contract that specified a peak demand limit (e.g., City of Wichita Falls customers). A summary of the findings is presented on Table 4-8.

Table 4-7 Peak Day Demands

Water User Group	Average Day Demand (MGD) Year 2000	Peaking Factor[1]	Peak Day Demand (MGD) Year 2000
Archer City	0.29		0.57
Holliday	0.21		0.41
Lakeside City	0.16		0.32
Scotland	0.20		0.40
Seymour	0.65		1.31
Byers	0.08		0.16
Henrietta	0.62	2.0	1.25
Petrolia	0.09		0.18
Paducah	0.34		0.67
Crowell	0.28		0.56
Chillicothe	0.11		0.22
Quanah	0.55		1.10
Guthrie	0.07		0.14
Bowie	0.97	2.25	2.19
Nocona	0.62	1.66	1.03
Saint Jo	0.13		0.25
Burkburnett	1.68	1.70	2.86
Electra	0.55		1.10
Iowa Park	1.19		2.38
Pleasant Valley	0.09		0.18
Wichita Falls	20.47	2.25	46.06
Vernon	2.60		5.20
Olney	0.65	1.87	1.22

1. For those cities without a given peaking factor, a factor of 2 was assumed.

As shown on Table 4-8, only the City of Wichita Falls may experience system limitations due to the capacities of their water treatment facilities. The other municipalities within the region appear to have sufficient capacities to transport and treat peak demands. However, the City of Scotland and several water supply corporations in Archer County appear to have contractual limits that are less than the projected peak demands. Further review of their respective contracts and water use may be warranted to ensure peak demands can be met.

Table 4-8 Water User Groups with System Limitations

								Peak Demand (MGD)					
Water User Group	County	Supply Source	Basin	WTP	Transmission	Supply	Limit (mgd)	2000	2010	2020	2030	2040	2050
City of Wichita Falls (treated water provider)	Wichita	Wichita System	Red	x			54.6	57.08	57.00	56.46	56.35	56.46	56.92
County- Other	Archer	Wichita System	Red			x	0.9	1.05	1.06	1.02	1.00	0.98	0.96
Scotland	Archer	Wichita System	Red			x	0.25	0.40	0.40	0.38	0.37	0.37	0.36

The limit specified for City of Wichita Falls is the existing capacity of the water treatment plant. The peak demands for the City of Wichita Falls are the sum of the peak demands of all customers with existing contracts for treated water. Customers who receive raw water are not included.

The limit for County – Other, Archer County, reflects existing contractual limits between the City of Wichita Falls and Archer County WSCs. County other peak day demands are based on the percentage of supply historically provided by the Wichita System.

The limit for Scotland is the contractual limit for treated water from the City of Wichita Falls. The peak demands are based on the projected demands for the City of Scotland with a peaking factor of 2.

4.6 System Operations and Reliability

The analysis for current surface water supplies within the region is based on the firm yield of the reservoirs. This approach is required by the Senate Bill One regulations, but it is often not reflective of how reservoir yields have been determined in other planning efforts. Firm yield analyses determine the amount of water that is available on an annual basis during a repeat of historical drought of record condition assuming all the water in the reservoir is available for use. This means that the reservoir content will approach zero sometime during the drought period if the firm yield is used. This analysis is also based on the historical rainfall and runoff for each reservoir. Experts at the University of Arizona's Climate Assessment Project for the Southwest recently indicated that Texas might be heading into a significant dry period. Since 1995 climatic patterns have shifted, bringing warmer drier weather to the Southern United States. This phenomenon called the Pacific Decadal Oscillation usually lasts 20 to 30 years (San Antonio Express News, 2/7/00). If this happens, then the region may be entering a new drought period that may surpass the historical drought of record and the firm yield may overestimate the available water supply. However, it is still too early to assess the impact of this weather shift.

Based on these concerns and the uncertainties inherent with the yield analyses, the available water supply for the region may be less than estimated in Chapter 3. For these reasons, most water supply systems will not allow their reservoir contents to drop to very low levels without utilizing alternative supplies and implementing drought contingency measures. Many cities within Region B have recently initiated drought contingency measures in response to continuing dropping reservoir levels and are actively considering alternative water sources.

To provide a more conservative estimate of the available surface water supply within the region, a safe yield analysis was conducted for the two largest reservoirs in Region B: Lakes Kickapoo and Arrowhead. Both these lakes are operated by the City of Wichita Falls and provide a large portion of the municipal supply in Region B. Many of the users of the smaller reservoirs in the region are supplemented with water from this system.

The safe yield analysis utilizes the same historical hydrology as the firm yield analysis, but assumes that a one-year supply of water is reserved in the reservoir at all times. This analysis has been commonly used for water resource planning in this region in the past. However, the one-year reserve amount may still be less than the preferred minimum operating content. For the City of Wichita Falls, severe drought contingency measures are initiated when the content of the Wichita System drops below 40 percent (137,000 acre-feet), which is much greater than a one-year reserve. Using existing reservoir operation models, the safe yields for the Wichita System for years 2000 and 2050 are estimated at 41,400 and 36,900 acre-feet per year, respectively. This represents a decrease in annual supply from the firm yield analysis of approximately 18 percent by 2050.

To assess the effect of this reduction in available supply on the City of Wichita Falls, a summary of supply and demand for the City is presented on Table 4-9. This analysis assumes that Wichita Falls' customers are entitled to their full contracted amounts, and any contracted supplies in excess of their needs are not available to the City of Wichita Falls. As a result, there are not sufficient supplies to meet contractual obligations and City of Wichita Falls demands. Therefore, the City of Wichita Falls may need to develop alternative supplies to maintain a minimum operation content of approximately 40,000 acre-feet in the Wichita System.

Table 4-9 Safe Yield Analysis for the Wichita System

	2000	2010	2020	2030	2040	2050
Safe Yield Supply						
Kickapoo	12,400	12,300	12,200	12,100	12,000	11,900
Arrowhead	29,000	28,200	27,400	26,600	25,800	25,000
Wichita System	*41,400*	*40,500*	*39,600*	*38,700*	*37,800*	*36,900*
Existing Customers (Contracted Amount)	17,359	17,464	17,547	17,627	17,729	17,927
Manufacturing Increase (see Table 4-1)	270	302	330	357	389	414
Wichita Falls (remaining supply)	23,771	22,734	21,723	20,716	19,682	18,559
Demands						
Wichita Falls	22,946	22,905	22,676	22,621	22,665	22,836
Needs						
Wichita Falls	825	-171	-953	-1,905	-2,983	-4,277

Safe yield analyses were conducted using reservoir operation studies developed by TWDB (1997).

4.7 Summary of Regional Needs

In Region B, water supply needs were identified for three water users, Electra, Vernon and manufacturing needs in Wilbarger County. This means that the existing water supplies to these users will not support the projected demand through the planning period. Both Vernon and Electra are aware of these needs and are currently looking for new water sources. There are existing supplies in excess of the demands in the region, and these options will be explored in more detail in Chapter 5.

In addition to the water supply needs, the Cities of Vernon and Electra are experiencing water quality issues with their groundwater supplies. Nitrates in excess of the current drinking water standard were identified for the several Seymour Aquifer users in Baylor, Clay, Foard, Wichita and Wilbarger counties. Approximately 5,400 acre-feet of allocated municipal supply do not meet the nitrate standard. These concerns are also currently being addressed by the local entities, and will be further discussed in Chapter 5.

Salinity levels in area lakes and aquifers are a continuing water quality concern within the region. Existing chloride control projects, such as the Truscott Brine Reservoir, are reducing chloride concentrations in Lake Kemp and Diversion, but the full impact has not been realized. Completion of the additional chloride control structures should further reduce the salinity levels in this water source. This will result in more water available for municipal use (by decreasing the required blending amount) and enable irrigators to grow a wider diversity of crops.

The municipalities in Region B generally have sufficient system capacities to treat and transport the available supplies, considering projected peak demand conditions. The City of Wichita Falls was the only identified city that may not be able to treat sufficient water to meet peak demands for all its treated water customers at the same time. This scenario may not happen, however, the water treatment plant capacity may limit the City in providing treated water to new customers or increase supply to existing customers.

Based on a safe yield analysis of the Wichita System, the City of Wichita Falls may need to utilize alternative supplies to maintain a one-year reserve in the Wichita System. The City has municipal rights in Lake Kemp and Diversion that could be used, but water quality issues limit this source. The City is currently exploring other alternatives to increase the reliability of their supplies and these will be discussed in Chapter 5.

4.8 Entities with Supplies in Excess of Needs

As shown on Table 4-10, there appears to be excess supply for the Cities of Bowie (from Amon Carter Lake), Burkburnett, Iowa Park, and Olney. With the exception of Bowie, all these cities receive water from the Wichita System. For these cities, the allocated supplies from the Wichita System are based on contract amounts that are determined from peak flow requirements. These contracts are used for supplemental supply needed to meet peak summer demands. Most likely, these cities do not receive the fully allocated annual amount, and therefore do not have a large surplus supply. This indicates that there may be additional supply for the City of Wichita Falls, but there is limited peak treatment capacity.

For the irrigation uses in Baylor, Hardeman and Wilbarger Counties, water is supplied primarily from groundwater. Groundwater for irrigation is typically used on a local basis and existing well fields may not be appropriate for other identified regional needs. However, the apparent reduction in irrigation use in these counties should reduce the stress on the respective aquifers, allowing continued use from these sources for other needs.

Other users with supplies in excess of 1,000 acre-feet per year include irrigation supply in Wichita County. This supply is allocated from Lake Kemp, which may not be suitable for municipal needs due to its salinity levels.

As a major water provider, the City of Wichita Falls has supplies in excess of their customers' projected needs (Table 8, Appendix A). However, most of these supplies are committed by contracts. As discussed above, these contracts specify a daily maximum rate. If an annual amount, as well as the daily rate, is specified on future contracts, then additional raw water may become available for other uses.

Regional surface water reservoirs and groundwater supplies in excess of the allocated amounts are shown on Table 4-11. Most of these supplies are groundwater sources that are not currently developed, but may be utilized to meet projected needs. The North Fork Buffalo Creek Reservoir, the only reservoir not fully allocated, has an estimated reservoir yield slightly greater than the water right. However, the yield analysis was not based on direct reservoir measurements and may not accurately reflect the true yield. If this source is considered for additional supply, a more detailed yield study will be needed.

Table 4-10 Water User Groups with Supply in Excess of Needs of 1,000 Ac-ft/yr

KEY	WATER USER GROUP	COUNTY	BASIN	SOURCE	2000	2010	2020	2030	2040	2050
**	IRRIGATION	BAYLOR	BRAZOS	Seymour	1,335	1,350	1,364	1,378	1,392	1,406
*	COUNTY-OTHER	CLAY	RED	Wichita System	1,420	1,483	1,556	1,598	1,659	1,610
**	IRRIGATION	HARDEMAN	RED	Blaine	2,296	2,446	2,591	2,732	2,869	3,002
	BOWIE	MONTAGUE	TRINITY	Amon Carter	1,367	1,404	1,411	1,392	1,361	1,327
*	BURKBURNETT	WICHITA	RED	Wichita System	1,824	1,846	1,883	1,888	1,884	1,869
*	COUNTY-OTHER	WICHITA	RED	Wichita System	2,214	2,164	2,157	2,165	2,164	2,181
*	IOWA PARK	WICHITA	RED	Wichita System	1,451	1,480	1,494	1,96	1,492	1,482
	IRRIGATION	WICHITA	RED	Kemp	12,245	9,863	6,577	3,293	17	0
**	IRRIGATION	WILBARGER	RED	Seymour	4,918	5,490	6,045	6,583	7,105	7,612
	STEAM ELECTRIC POWER	WILBARGER	RED	Kemp	11,900	8,000	4,000	0	0	0
*	OLNEY	YOUNG	BRAZOS	Wichita System	1,301	1,304	1,324	1,338	1,351	1,359

Key: * - Receives all or portion of supply from the Wichita System. ** - Receives all or most of supply from groundwater

Note: Supplies in excess of needs are based on firm yield analysis. The City of Wichita Falls also shows an excess of needs for firm yield analysis, but indicates a shortage for safe yield analysis. Therefore, the City of Wichita Falls is not included on this table.

Table 4-11 Regional Supplies Not Allocated to a User Group (Greater than 1,000 Ac-ft/yr)

WATER SUPPLY SOURCE	COUNTY	2000	2010	2020	2030	2040	2050
N.F. BUFFALO CREEK RESERVOIR	WICHITA	1,260	1,260	1,260	1,260	1,260	1,260
GROUNDWATER SOURCES							
SEYMOUR	BAYLOR	8,696	8,696	8,696	8,696	8,696	8,696
SEYMOUR	CLAY	7,114	7,114	7,114	7,114	7,114	7,114
BLAINE	COTTLE	22,575	22,575	22,575	22,575	22,575	22,575
SEYMOUR	COTTLE	8,473	8,473	8,473	8,473	8,473	8,473
BLAINE	FOARD	15,367	15,367	15,367	15,367	15,367	15,367
SEYMOUR	FOARD	7,105	7,105	7,105	7,105	7,105	7,105
BLAINE	HARDEMAN	16,770	16,770	16,770	16,770	16,770	16,770
SEYMOUR	HARDEMAN	17,815	17,815	17,815	17,815	17,815	17,815
BLAINE	KING	16,630	16,630	16,630	16,630	16,630	16,630
TRINITY	MONTAGUE	2,020	2,020	2,020	1,570	1,570	1,168
SEYMOUR	WICHITA	10,896	10,896	10,896	10,896	10,896	10,896
SEYMOUR	WILBARGER	6,973	6,973	6,973	6,973	6,973	6,973

Note: Surface water supplies are based on firm yield analyses.

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